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SURVIVAL OF TROPICAL ASH PLANTED IN TORDON-TREATED SOILS IN HAWAII

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Abstract: Tropical ash *(Fraxinus uhdei* [Wenzig] Lingelsheim*)* seedlings were planted 5 to 9 weeks after summer and winter applications of 5, 10, 15, and 30 pounds of Tordon 10K pellets per acre on a site on the island of Hawaii and on another site on Molokai. Eighty percent of them survived. Replanting was required for that survival rate when 30 lbs. were applied in summer. Increasing the time between treatment and planting, thereby allowing more rain to leach the herbicide, would probably eliminate the need for replanting. The appearance of a seedling was not always an adequate indicator of the presence of Tordon 10K because some seedlings in the untreated control plots appeared to have been affected by the herbicide.

Oxford: 226(969):441–414.12 Tordon 10K:176.1 *Fraxinus uhdei.*
Retrieval Terms: Fraxinus uhdei; Hawaii; conversion (silvicultural); herbicide side effects; Tordon 10K; seedling survival.

In soils treated with Tordon 10K herbicide,[1] the rate and depth of leaching depends on rainfall, soil texture, and organic matter content. Normally, leaching increases as rainfall increases.[2] Tordon is easily leached through medium- and light-textured soils—especially soils low in organic matter.[3] It is not uncommon for this herbicide to leach to a depth of 24 inches in 3 months. Leaching may even reach depths of 4 feet.[4] Tordon is persistent—about 20 percent remains in the soil after a year.[2,4]

How soon can seedlings be successfully planted after Tordon 10K has been applied to the soil? To find out, I made an exploratory study that provided some answers. Seedlings of tropical ash *(Fraxinus uhdei* [Wenzig] Lengelsheim*)* were planted on two sites in Hawaii where the effects of Tordon 10K on existing forest vegetation were being studied.[5]

The results suggests that tropical ash seedlings can be successfully planted a relatively short time after Tordon 10K is applied if weather and edaphic factors favor rapid leaching of the herbicide. Adequate rain must fall after application to leach the herbicide. Successful plantings (at least 80 percent survival) were obtained after only 5 to 9 weeks, except for seedlings planted in plots treated in summer at the rate of 30 pounds of Tordon per acre.

METHODS

Tordon 10K was applied at rates of 5, 10, 15, and 30 pounds of active ingredients per acre on two different sites—Paauilo and Kalamaula. Untreated plots served as controls.

Site Selections

The Paauilo site lies on the northeast slopes of Mauna Kea on the island of Hawaii, at 2,200 feet elevation. Rainfall here averages 85 inches annually, with about 70 percent falling between November and

April. Topography is undulating, with a major slope of about 10 percent. The soil–a Honokaa silty clay loam is deep, well-drained, and of moderately high organic matter content–commonly as high as 18 percent. The vegetation consisted of an overstory of dense firetree *(Myrica faya* Ait*)* and an understory of strawberry guava *(Psidium cattleianum* Sabine*)*. Several large avocado *(Persea americana* Mill.*)* trees and many herbaceous species also were found here.

The Kalamaula site is on the island of Molokai, at 2,350 feet elevation. About 70 percent of the 40 to 50 inches of annual rainfall occurs between November and April. The site is on a broad ridge that slopes at about 5 percent to the west-southwest. The Naiwa silt loam soil is deep, well-drained, and has a high organic matter content. The vegetation consisted of a sparse stand of scrub ohia *(Metrosideros collina* [Forst.] Gray*)* trees and an understory of 'akia *(Wikstroemia* ssp.*)*, 'a'ali'i *(Dodonaea* ssp.*)*, guava *(Psidium* ssp.*)* and pukiawe *(Styphelis tameimeiae* Cham. F. Muell.*)*. Many herbaceous species were also present.

At each site, two sets of plots were established–one for each of two treatment dates: (a) Paauilo site–June 16 and November 7, 1967; (b) Kalamaula site–June 10 and December 15, 1967. A set of plots consisted of five 1/10-acre square plots, one plot for each Tordon treatment. The Tordon 10K pellets were applied by hand to each set of plots.

Planting Seedlings

Tropical ash seedlings were planted in each set of plots from 5 to 9 weeks after the herbicide was applied. Ten bare-root seedlings were planted in each plot at spots selected at random from a grid of 20 points. The seedlings averaged about 1 foot tall. No vegetation on the herbicide treated plots was removed when the seedlings were planted. But in the control plots, the vegetation within a 3-foot radius around each planting spot was removed. No further weeding was done.

About 4 weeks after planting, seedling survival and health was checked. If survival was less than 80 percent, dead seedlings were replanted. Eighty percent was decided upon because it is not uncommon to have 20 percent of the seedlings lost in general field plantings from transplant shock, drought, or planting technique. Replacement seedlings were planted about 1 foot away from the dead seedlings.

Seedlings were rated as healthy or unhealthy depending on the condition of their terminals and leaves. Seedlings with symptoms typical of herbicide toxicity–discolored or curled leaves or with twisted, discolored, or dead terminals–were rated as unhealthy.

RESULTS AND DISCUSSION

Effectiveness of the herbicide on existing forest vegetation on the Paauilo and Kalamaula sites was related to the rate and season of application. Summer applications proved to be more effective than the winter applications. This finding was to be expected because herbicides are generally more effective when applied during the growing season. The effectiveness of the herbicide on the existing forest vegetation

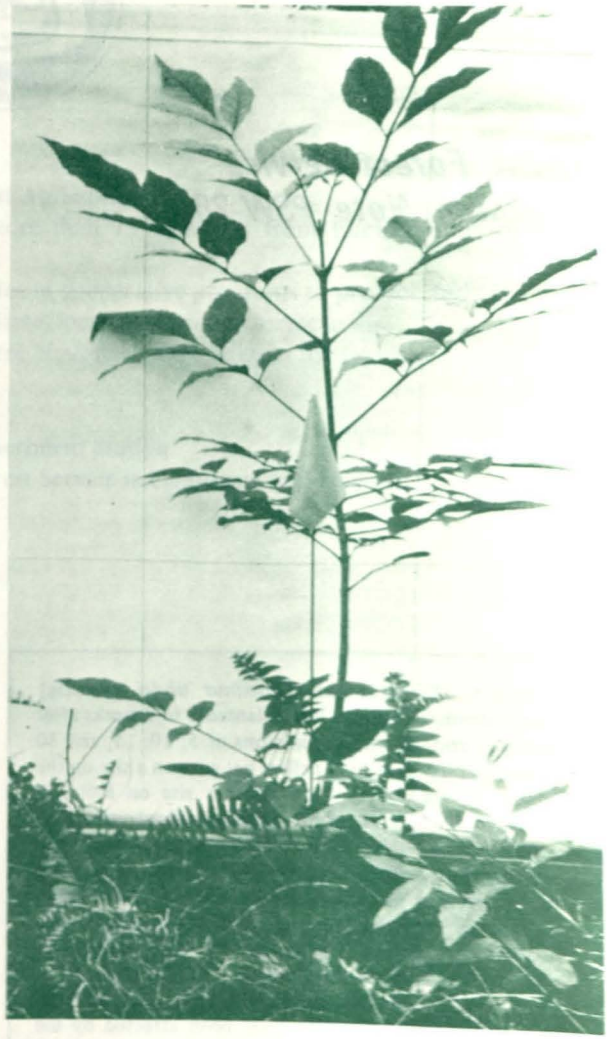

Figure 1–This tropical ash seedling was planted about 2 months after soil was treated with 30 pounds active ingredient per acre of Tordoh 10K. In 5 months it grew more than 2 feet and showed no effect of the herbicide.

Table 1–*Number of living and healthy tropical ash seedlings at two sites in Hawaii, by rate of Tordon 10K application, season of and months after first planting of seedlings*

Months after first planting	Planted in Paauilo Site[1], Hawaii, in . . .				Months after first planting	Planted in Kalamaula Site[1], Molokai, in . . .			
	Summer		Winter			Summer		Winter	
	Alive	Healthy	Alive	Healthy		Alive	Healthy	Alive	Healthy
Rate: None (Control)									
1	10	1	10	10	1	10	10	10	8
2	10	0	10	10	3	10	9	10	7
6	10	10	10	10	6	10	10	10	7
Rate: 5 lbs. per Acre									
1	10	0	9	5	1	10	10	10	5
2	10	0	8	4	3	10	9	10	8
6	10	10	[2]8	8	6	10	10	10	10
Rate: 10 lbs. per Acre									
1	10	3	10	4	1	10	10	10	7
2	5	0	10	8	3	10	10	10	8
6	[3]10	10	8	7	6	9	7	10	7
Rate: 15 lbs. per Acre									
1	10	2	10	4	1	10	1	10	7
2	9	0	9	8	3	9	6	10	8
6	8	8	9	9	6	9	9	10	9
Rate: 30 lbs. per Acre									
1	9	0	10	1	1	10	6	10	3
2	2	0	8	4	3	5	5	10	6
6	[4]9	6	8	7	6	[5]8	7	10	9

[1]10 seedlings originally planted in each plot.
[2]1 replanting of 4 seedlings at 5 months.
[3]2 replantings - 5 seedlings at 2 months, 5 seedlings at 3 months.
[4]2 replantings - 8 seedlings at 2 months, 3 seedlings at 3 months.
[5]1 replanting of 5 seedlings at 3 months.

increased as rates of application increased. Only the summer application rates of 15 pounds or more active ingredient per acre effected 80 percent or greater kill of existing forest vegetation.

Adequate rainfall after application is important to carry the herbicide into the root zone of existing vegetation and out of the root zone of planted seedlings. The root zone of the planted tropical ash seedlings was the first 5 to 6 inches of soil. Rainfall from the time of herbicide application until the first planting at each site was:

	Treatment date	*Planting date*	*Rainfall (inches)*
Site:			
Paauilo	June 16	August 2	7
Paauilo	Nov. 7	Dec. 14	20
Kalamaula	June 20	August 31	8
Kalamaula	Dec. 15	January 25	24

Leaching was apparently sufficient in most cases to reduce the herbicide concentration in the soil around the seedlings roots to that below the phytotoxic level. One month after planting, all seedlings in each plot were still alive, except for two plots, which each had a dead seedling *(table 1)*. In the Paauilo plots treated in June with 30 pounds of Tordon per acre, seedling mortality reached 80 percent 2 months later. In the Kalamaula plots, also treated in June at the same rate, seedling mortality was 50 percent 3 months later. Mortality can be attributed to the herbicide. After 2 months mortality was 50 percent in the Paauilo plots that had been treated with 10 pounds of Tordon per acre in June. In this plot, the several large avocado trees may have intercepted rain and reduced leaching. Dead seedlings in all plots were replaced. However, many of the replants on the Paauilo plots died, probably because of the herbicide and generally dry soil conditions. A second replanting was required.

After 3 months, all plots on both sites had at least 8 trees surviving. At 5 months, four seedlings were dead on the Paauilo plot that had been treated with 5 pounds per acre in June. The cause of death could not be determined. The seedlings were replanted, but

only two of the four survived because of dry soil conditions. No further mortality occurred.

Some seedlings in all plots, including the controls were unhealthy; many exhibited symptoms of herbicide toxicity. Damage to seedlings in control plots could be due to transverse leaching across the narrow 10-foot buffer strip, or perhaps by extremely small amounts of the highly water soluble chemical being taken up by the moist air and moved across plot boundaries. Planting shock and dry spells probably accounted for some mortality and unhealthy seedlings. Some seedlings showed no symptoms and grew normally *(fig. 1)*.

NOTES

[1]Trade names and commercial enterprises or products are mentioned solely for necessary information. No endorsement by the U.S. Department of Agriculture is implied.

[2]Goring, C. A. I., C. R. Youngson, and J. W. Hamaker. *Tordon herbicide. . .disappearance from soils.* Down to Earth 20(4): 3-5. 1965.

[3]Hamaker, J. W. A., A. I. Goring, and C. R. Youngson. *Sorption and leaching of 4-amino-3,5,6-tricloropicolinic acid in soils.* Adv. Chem. Ser. 60: 23-37. 1966.

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[4]Hamaker, J. W., C. R. Youngson, and C. A. I. Goring. *Prediction of the persistence and activity of Tordon herbicide in soils under field conditions.* Down to Earth 23(2): 30-36. 1967.

[5]The studies were made by Charles A. Graham, range scientist, Pacific Southwest Forest and Range Experiment Station, stationed in Fresno, Calif.

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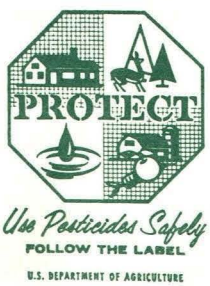

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